



## **A Systematic Approach for Conceptual and Sustainable Process Design: Production of Methylamines From Methanol and Ammonia**

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## A Systematic Approach for Conceptual and Sustainable Process Design: Production of Methylamines From Methanol and Ammonia

**Monday, October 29, 2012**

[Hall B \(Convention Center\)](#)

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Methylamines are very important chemicals as they are commonly used as intermediates for a wide range of agricultural chemicals, animal nutrients, catalysts, electronics, explosives, fuel additives as well as gas and oil treatments.

A systematic method is applied to design a sustainable and environmentally acceptable plant for producing mono-methylamines, di-methylamines and tri-methylamines from methanol and ammonia. The systematic method divides the process design work into 12 sequential tasks that covers all stages of conceptual design, starting from the consideration of qualitative aspects of the process flow sheet and preliminary calculations to the detailed process simulations, equipment sizing, costing, an economic evaluation, and sustainability of the designed process. At the end of task-9, the base case design is obtained, which is then further refined and improved with respect to heat integration and process optimization. In the final task-12, a sustainability and life cycle assessment (LCA) analysis is performed to assess the environmental impact of the process design. This is done through the following special software: SustainPro and LCASoft, which determine the key sustainability and LCA measures such as sustainability metrics for environment, economic and social; carbon footprint; safety index and many more. In addition, PRO/II is used for process simulation (for verification of design), ICAS for property prediction and analysis of design options; ECON for cost and economic analysis.

The annual profit of base case is estimated to be about 6 million USD with a payback time of 2 years for production rates of 1200 kg/hr, 4150 kg/hr and 1100 kg/hr of mono-methylamine (MMA), di-methylamine (DMA) and tri-methylamine (TMA), respectively. The capital and operating costs are divided into the individual cost items. It is found that compressors are the most expensive equipment and the steam utility is the main contributor to the total operating cost. A new conceptual typical separation method using gas hydrate formation was also proposed for the first time in this report and has not been reported elsewhere. This information is then used as target for process improvement by heat integration and process optimization, thus increasing the annual profit and reducing the payback time. The environmental impact analysis identifies impact due to the release of chemicals. The environmental impact analysis identifies impacts due to the release of chemicals and points to the need of better control mechanisms through the sustainable LCA analysis.

The design project was carried out under the supervision of Professor Rafiqul Gani.

**Extended Abstract:** File Uploaded

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